

Final Performance Report

Contract # **FA9550-08-C-0006:**

Hearing Protection for High-Noise Environments

Period of Performance: **Oct 01, 2007 – Nov 30, 2009**

Attachment 5

CONSTRUCTION OF THE HUMAN HEAD MODEL

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Report Documentation Page			Form Approved OMB No. 0704-0188		
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1. REPORT DATE 2009	2. REPORT TYPE		3. DATES COVERED 01-10-2007 to 30-11-2009		
4. TITLE AND SUBTITLE Construction of the Human Head Model			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) MONOPOLE RESEARCH,739 Calle Sequoia,Thousand Oaks,CA,91360			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Summary

A precise model of the cochlea and its vicinity is essential for reliable numerical simulation which could discern between different mechanisms of energy transfer to the human ear.

Therefore, a significant fraction of our effort was devoted to the construction of a sufficiently detailed and anatomically faithful model of the ear (its outer, middle, and inner parts). The model we constructed consists of the following parts:

1. the outer ear represented by its exterior surface, the surface of the auditory canal including the tympanic membrane, modeled as a finite-thickness surface;
2. the middle ear, modeled as a surface of the system of ossicles and supporting structures;
3. the inner ear, modeled as a set of surfaces representing the boundaries of the cochlea, the vestibule, and the semi-circular canals;
4. the skull, described by the surface of the bone;
5. the outer surface of the skin surrounding the skull; and
6. a homogeneous material filling the space between the skull and the inner ear.

For tests of noise-protection devices, we also included a model of a helmet and the material layer filling the space between the helmet and the surface of the head.

We stress that all the geometry components: skull, skin, inner, middle, and outer ear, as well as the helmet, are mutually compatible and matched to one another.

Some representative examples of the geometry details are presented in Figs. 1 to 8.

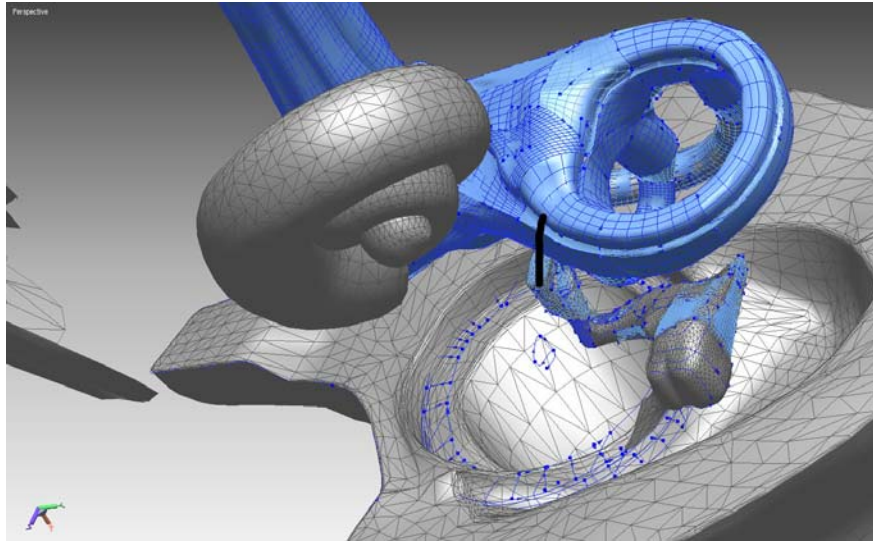


Figure 1: A part of the inner ear structure: the cochlea and the semi-circular canals.

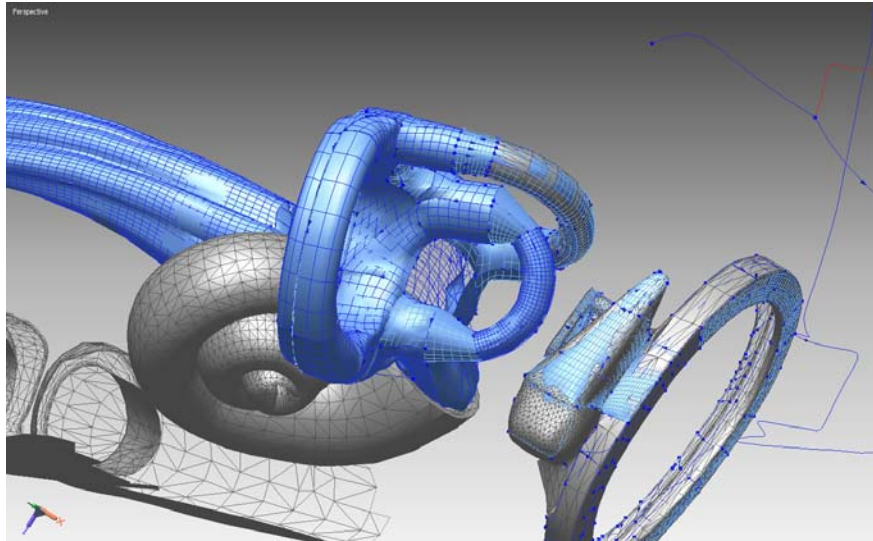


Figure 2: Another view of the cochlea, the semi-circular canals, and the adjacent structures.

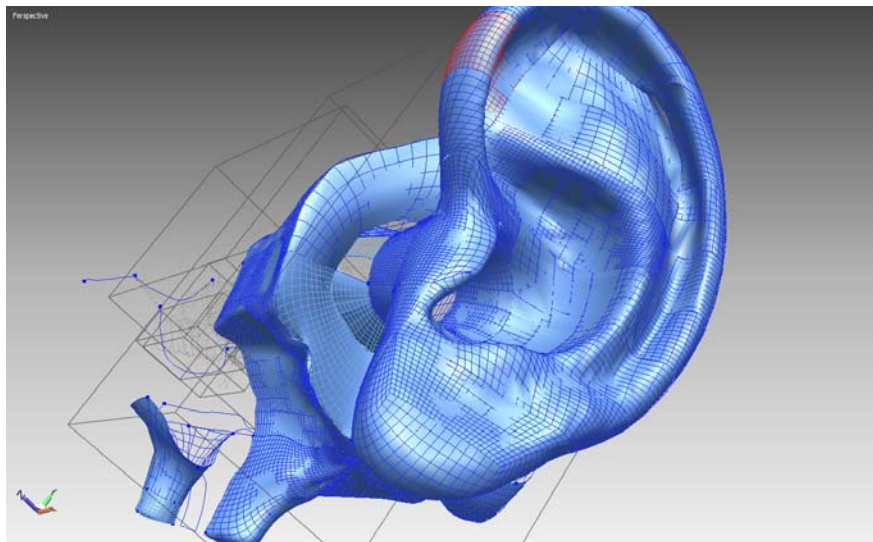


Figure 3: A view of the outer ear and the adjacent part of the skull.

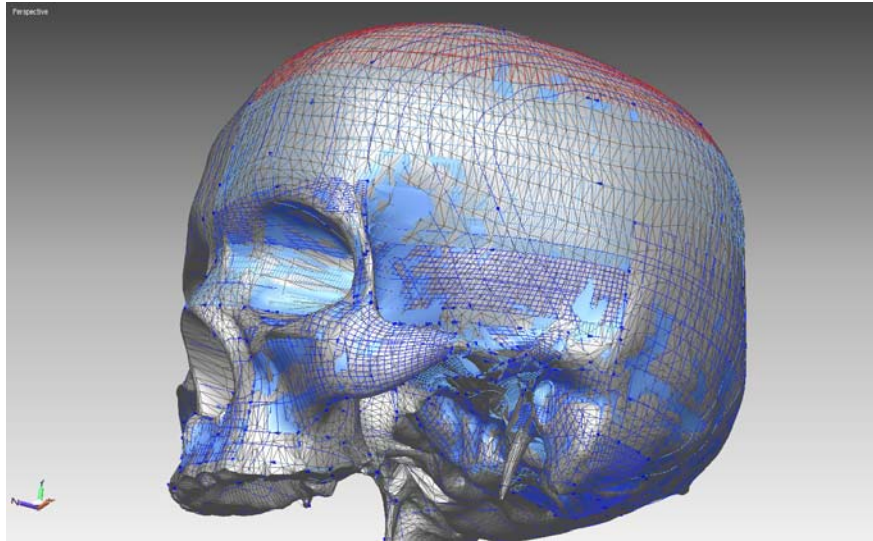


Figure 4: The overall view of the skull model.

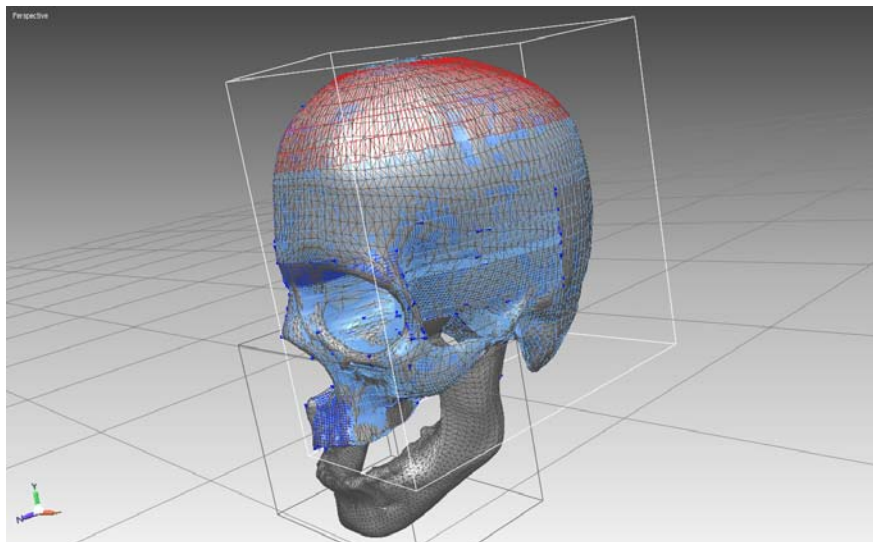


Figure 5: A view of the skull model, including the lower jaw.

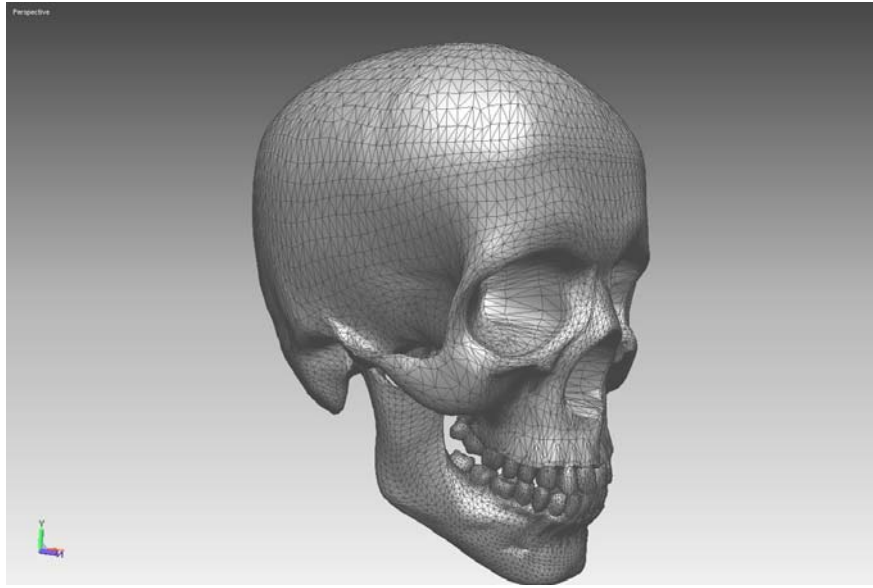


Figure 6: Another view of the complete skull model.

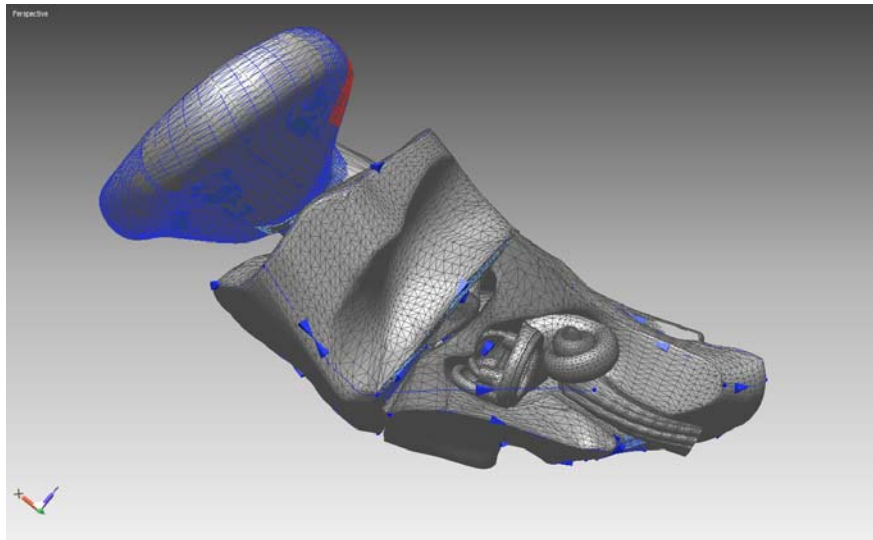


Figure 7: The outer ear and the inner ear structure embedded in the skull bone.

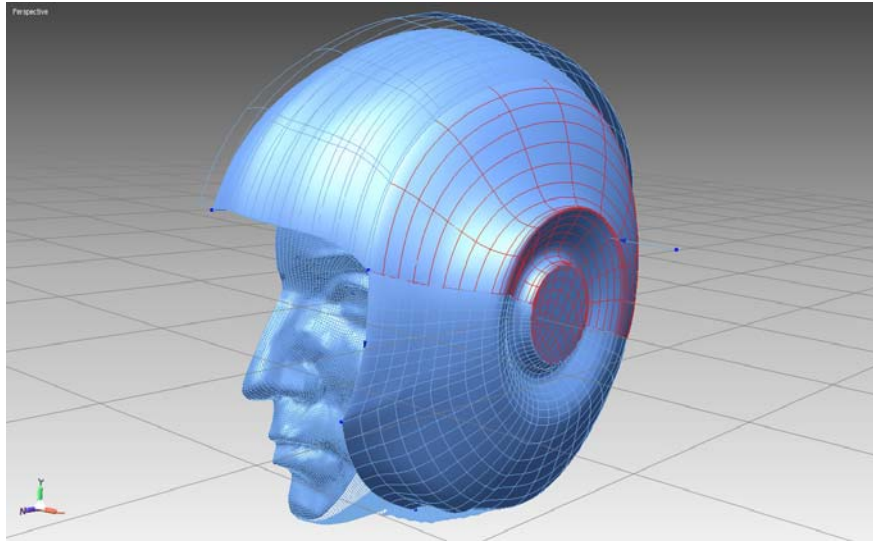


Figure 8: The model of the head skin surface and the matched helmet.